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An Experience Sampling Study into Stress and the Presence of Friends

MASTER THESIS

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Abstract

Background. Nowadays stress constitutes a social phenomenon, and a constituent feature of university student's everyday life, which might potentially have serious consequences. Most research assessed stress as a trait-like construct, assuming that stress is relatively stable over time. But, stress can also be considered as a state fluctuating over time within individuals. Moreover, stress levels were found to be highly context dependent. Previous research found that people seem to be less stressed in the presence of their friends. However, there is a lack of research focusing on the role of context and considering the nonergodic nature of stress as a psychological phenomenon, which is inherently dynamic and fluctuates within individuals over the course of time. **Objective.** The aim of the current study was to investigate how the presence of friends correlates with momentary fluctuations of stress within individuals over time. **Method.** Experience sampling (ESM) was chosen as the method for this study, since it allows for longitudinal measurements of stress, as it unfolds within individuals in their real-life context. In total, 35 university students participated in the online study (*M age* = 20.65). Over the course of seven days, participants completed several questionnaires three times a day. Finally, the Perceived Stress Scale (PSS) was used to assess trait stress. **Results.** It was found that 60% of the sample showed moderate and 40% showed high levels of trait stress on the PSS ($M = 24.60$, $SD = 5.34$). In line with the expectations, it was found that state stress fluctuated within persons respective trait stress ranges. Results of a linear mixed model revealed that trait stress significantly predicted state stress within the sample ($p < 0.001$). However, the presence of friends was not significantly related to decreased levels of stress and no significant moderation of this association by trait stress was observed. Moreover, an interaction effect of trait stress on the relation between the presence of friends and state stress could not be found within the present sample ($p = 0.980$). **Conclusion.** Results of the present study confirm the high levels of stress among university students. Levels of stress were not significantly associated with being in the presence of friends. Moreover, the present study showed the suitability of ESM to gain insights into patterns of stress and potentially related factors within persons in their real-life context. Further application of ESM studies with a larger sample size is recommended to clarify remaining questions about stress and its predicting and moderating factors.

Keywords: stress, friends, experience sampling, university students, linear mixed model

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Introduction

People nowadays live in a fast-paced world, which is continuously changing and developing. Constantly emerging innovations are aimed to contribute to an increased quality of life and they provide us with unique opportunities in almost all aspects of human being. For instance, the newest technologies have opened up a world of new possibilities and they have made our lives much more convenient. Nevertheless, these developments come with certain costs. Today's society is characterized by pressure to perform, competition and striving for perfection. All these factors contribute to feelings of stress among the population. For instance, the American Institute of Stress recently found that about 80% of a sample experienced stress on the job. Moreover, it was found that stress-related disorders recently increased alarmingly (Mirzaei, Yasini Ardekani, Mirzaei, & Dehghani, 2019). It was revealed that 45% of undergraduate college students who seek counselling, do this due to their high levels of stress (Winerman, 2017). Hence, stress can be considered as a constituent feature of everyday life in the modern world and it constitutes a social phenomenon, which might potentially have serious consequences.

Although stress is a common phenomenon, there is no universal definition of stress. Instead, there are several definitions, which slightly differ from each other. A well-established definition of stress is 'physical, mental, or emotional strain or tension' (The American Institute of Stress, 2020). Another common definition of stress is 'the perception of threat, with resulting anxiety, discomfort, emotional tension and difficulty in adjustment' (Fink, 2016). It is noticeable that most definitions of stress emphasize the negative aspects of stress. But, this is too simplistic and does not represent a holistic picture of what stress actually is. Essentially, stress is a lifesaving response to solve short-term and life-threatening problems (The American Institute of Stress, 2020). Stress is a fundamental part of the human 'fight or flight' response, which allows humans to adapt to external circumstances. Nowadays, stress is often distinguished into two categories: eustress and distress. Eustress can be defined as a form of stress which aims to increase the adaptive capacities of humans (Kupriyanov & Zhdanov, 2014). Eustress can stimulate and motivate us to pursue and to complete a task, like inter alia developing a new skill or studying for an exam. Hence, eustress might be considered as the form of stress which causes positive or adaptive reactions to stressors (Simmons & Nelson, 2001). In contrast to that, distress refers to the maladaptive responses to a certain stressor. Actually, distress can be defined as the unpleasant form of stress and it was found to be related to depression or burnout (The American Institute of Stress, 2020).

The potential consequences of stress are diverse. Eustress was found to be related to health promoting behaviors, such as sport. In contrast, distress was found to be related to health endangering behaviors, such as substance use and lack of physical activity (Hassanbeigi, Askari, Hassanbeigi, & Pourmovahed, 2013). In the past few years, several studies have found a significant link between distress and certain medical conditions. For instance, a study in 2014 found that there was a significant correlation between chronic stress and physical complaints, such as pain and inflammation (Hannibal & Bishop, 2014). Stress was also found to be related to psychological problems, such as burnout or depression.

Generally, the mental health condition seems to be worse for stressed people. A study conducted in 2017, revealed that 86.3% of a stressed sample of university students, also manifested symptoms of anxiety (Saleh, Camart, & Romo, 2017). Thus, there seems to be a link between stress and anxiety. Several other studies support this finding, and it was found that mental health problems among university students have recently increased in both number and severity (Hunt & Eisenberg, 2010). Actually, stress was not only found to have a negative impact on physiological and psychological wellbeing, but also on academic performance. It was found that distress was directly linked to lower academic achievement and to increased thoughts of dropping out among university students (Dyrbye et al., 2011; Stallman, 2010). This is also in line with the findings of a study, in which a sample of university students identified stress as the primary factor impeding their academic achievements (American College Health Association, 2009). Moreover, a study in 2018 found that chronic stress was related to cognitive impairments, affecting the memory and learning capacities of students (Aafreen, Priya, & Gayathri, 2018). To summarize, stress manifests itself in various areas and the consequences might be severe, including those for students. Therefore, it is important to carefully consider the factors that are related to stress, in order to eventually counteract the detrimental effects of stress.

There are several factors that influence stress and its effects. A study conducted in 2017, found that life satisfaction was one of the most important predictors of stress (Saleh, Camart, & Romo, 2017). In order to understand this finding better, it should be discussed more in depth. Life satisfaction as one of the most important factors influencing stress, refers to an individual's subjective wellbeing. Life satisfaction can be considered as an umbrella term, which is composed of several factors, such as self-concept and social relations (Saleh, Camart, & Romo, 2017). For instance, it was found that people with more substantial networks of active social relationships tend to be more satisfied and happier with their lives (Amati, Meggiolaro, Rivellini, & Zaccarin, 2018). This means that friendships might enhance life satisfaction. Since

life satisfaction was found to be a crucial factor influencing stress, it could be assumed that friendship and more specific the presence of friends has a positive influence on stress, via its effects on life satisfaction. Indeed, a study found that social support manifested itself as a buffering factor against the negative effects of high stress levels (Cohen & Hoberman, 1983). The findings of another study also suggested that positive peer relations buffer against the effects of high stress (Rubin et al., 1992). Similarly, it was found that affectionate interaction has a stress-buffering effect (Floyd, Pauley, & Hesse, 2010). Generally, the finding that positive peer relations buffer against stress, could be related to the fact that friendships usually provide individuals with positive emotions. Positive emotions and their effects can be best understood in terms of the 'broaden and build theory' developed by Fredrickson. This theory assumes that positive emotions such as pleasure or joy, open up and expand the way a person thinks or acts. This in turn, enables the individual to interact more efficiently with others, thus to experience more positive relations (Fredrickson, 2005). By broadening the attention and building social resources, even more positive emotions can arise. As a result, a cycle emerges in which positive emotions and social resources, complement and reinforce each other. The cyclic interactions between positive emotions and social relations are crucial when it comes to stress. This is due to the fact that it was found that positive feelings enhance one's capacity to adapt to stress (Tugade & Fredrickson, 2004). In sum, it could be stated that positive emotions enhance positive peer relations, which in turn enables the individual to cope more efficiently with stress (Cohen & Hoberman, 1983).

To summarize, it could be stated that friendships provide individuals with positive emotions, which ultimately buffer against stress. Based on all these findings, there is already some support that the presence of friends has a positive effect on stress and its effects. So far, there is quite a lot known about stress and its causes and effects. Nevertheless, despite the current level of research, the number of stress related diseases is higher than ever (Mirzaei, Yasini Ardekani, Mirzaei, & Dehghani, 2019). Thus, it is a matter of urgency to conduct more research on stress and further untangle its association with contextual factors such as the presence of friends.

Currently, most research about stress examined stress as a trait-like construct, which is relatively stable over time. Nevertheless, emotions such as stress, are inherently dynamic and fluctuate over the course of time (Kuppens, Oravecz, & Tuerlinckx, 2010). Fredrickson, the founder of the 'broaden and build theory' defines emotions as 'multicomponent response tendencies that unfold over relatively short time spans' (Fredrickson, 2004, p. 146). From this definition, emotions could be considered as states, operating in momentary conditions.

Affective states are variable over time and they are highly context-dependent. Stress, as a state, is also likely to fluctuate over time. Capturing this variability is not only helpful to understand stress more in depth, but it might also allow us to predict the course of it (Myin-Germeys et al., 2018). This highlights the importance of assessing stress from moment to moment.

Even though previous research already investigated the relationship between trait-like stress and friendship, there is a need for further insights in this regard. Most research conducted on stress, employed a cross-sectional design with retrospective assessments. But, there is often a nonergodic nature of psychological phenomena, in which the results at the population level do not necessarily reflect within-person processes (Mehl & Conner, 2012, p. 47). Hence, there is a need to conduct more research, considering the within person processes. As a suitable methodology for this purpose, the experience sampling method (ESM) will be applied for the current study. This method enables researchers to study processes that unfold within individuals in real time in their daily life. By means of real-time data collection, stress can be investigated on a micro-level. This allows for longitudinal measurements among and within participants in their real-world context (Verhagen, Hasmi, Drukker, Van Os, & Delespaul, 2016). In addition to that, ESM allows the modelling of certain patterns within each individual and to test whether those patterns differ as a function of personal characteristics (Mehl & Conner, 2012, p. 43). Moreover, the recollection bias can be reduced to a minimum by employing ESM, which also increases the ecological validity. Investigating the relationship between momentary stress and being in the actual presence of friends on a micro-level, may help to move towards understanding, predicting, counteracting or even preventing stress and its effects on society. For instance, targeted interventions which take more contextual factors into consideration, could be designed based on the insights gained in the present study.

The aim of the current research was to investigate how the presence of friends is associated with fluctuations of stress within individuals. Due to the lack of representative research on stress as a state, the first research question was defined as ‘How does stress fluctuate within university students over time?’. In order to assess whether the friendship not only has a link to stress as a trait, but also as a state, the second research question was formulated as: ‘How does the presence of friends correlate with momentary fluctuations in stress within University students over time?’. Based on previous findings, it was assumed that there is a negative correlation between momentary stress as a state-like construct and being in the presence of friends.

Method

Design

The current study concerns a post-hoc analysis of data previously collected for a bachelor thesis of the University of Twente (Adam, 2020). For the implementation of the study, an experience sampling method (ESM) design was employed. This method allowed for a longitudinal intensive measurement of stress within individuals over time. In order to keep the participant burden low and the ecological validity high, the data collection was scheduled for one week. To assess the relatively frequent experiences of inter alia stress, interval-contingent sampling was used as the sampling strategy for this study. The fixed nature of the measurements standardizes the time span between the reports and enables researchers to make statistical comparisons within and between participants (Mehl & Conner, 2012, p. 96). A further advantage of applying interval-contingent sampling refers to the fact that this sampling strategy was found to be the least burdensome to participants. (Mehl & Conner, 2012, p. 96).

Participants

The inclusion criteria for participation in this study were to be a registered student, aged 18 or older and to possess sufficient English skills. Another requirement was to own a smartphone (either Apple or Android) in order to download and run The Incredible Intervention Machine (TiiM) application (The BMS Lab, n.d.). In total, 35 participants participated in the present research on a volunteer basis. The final sample consisted of 8.8% males, 85.3% females and 5.9% participants with other self-identified gender. Their nationality varied, and their age ranged from 18 to 31 years, with a mean age of 20.65 (SD = 3.15) years. Only participants who had a 100% response rate in the trait and state questionnaires were included in the analysis.

Materials

The present study was part of a bigger research project, consisting of an extensive battery of tests. This test battery comprised four trait questionnaires and six daily Experience Sampling (ESM) items. In the following, only the questionnaires and items relevant for the present study, will be described in more detail.

The Incredible Intervention Machine (TiiM)

The study was carried out by means of The Incredible Intervention Machine (TiiM), developed and owned by the University of Twente. TiiM is an advanced intervention tool, which can be used to set up longitudinal studies (The BMS Lab, n.d.). Here, questions can be clustered into sets, which can be made available to participants at predefined fixed points in time. At these time points, participants receive a notification on their mobile device. For the present research, three fixed time frames were used per day to randomly present the ESM items. These time frames were scheduled for 8 to 10 am, 12 to 2 pm, and 7 to 9 pm. Using TiiM as a computerized device for the data collection, is beneficial for time-based protocols, since compliance with timing can easily be validated.

Trait Questionnaire

Firstly, the Perceived Stress Scale (PSS) developed by Sheldon Cohen, was employed in order to investigate baseline trait levels of stress. This ten-item questionnaire constitutes a reliable measure to assess the extent to which individuals appraise their life as stressful. The items are answered on a 5-point Likert Scale, ranging from 'never' to 'very often'. Example items of the scale are 'In the last month, how often have you felt nervous and stressed?' and 'In the last month, how often have you felt that you were unable to control important things in your life?'. Four out of ten items (4, 5, 7, 8) needed to be reversed before scoring. Finally, the sum of all items represents the stress level of the individual, whereby a high score indicates high levels of perceived stress. The maximum score, which could be achieved on the scale, was 40. The University System of New Hampshire defined a scientifically founded norm table, to interpret the results on the PSS. They divided the perceived stress into three categories: low, moderate and high. According to them, scores ranging between 14 and 26, indicate a moderate stress level. A score of 27 or above, is considered as high perceived stress. The PSS showed to have established acceptable psychometric properties (Lee, 2012). The reliability of the scale was good (Cronbach's alpha above 0.70). Similarly, an acceptable construct validity was found. Cronbach alpha in the present study was found to be .90, which indicated an excellent reliability.

Daily Questionnaires

During the implementation of the study, participants were instructed to answer several questions three times a day. To avoid habituation in responding, the order of the daily questions were arranged randomly for each measurement within the defined time frames.

State Stress. In order to keep the participant burden low and to increase the response probability, state stress was assessed by means of a single item. The item was formulated as 'On a scale from 0 to 7 and seven being the worst stress possible, what number describes your level of stress right now?' and participants were instructed to indicate their current stress level on a 7-point Likert Scale, ranging from 0 (no stress) to 7 (worst stress possible). Previous research found that such single item measures of stress constitute a valid measure to draw conclusions about stress (Elo, Leppänen & Jahkola, 2003; Littman, White, Satia, Bowen & Kristal, 2006).

Social Context. To get a grasp of the social context, the participants were asked to indicate with whom they were at the time of the measurement. In order to minimize the participant burden, predefined answer categories were provided. The categories from which the respondents could chose were specified as 'Family', 'Partner', 'Friends', 'Fellow Students, Co-Worker', 'Other', and 'I am alone'. Hereby, it was possible to select several answer categories at the same time. The present study exclusively considered whether friends were present or not. Hence, the other response categories were not taken into account.

Procedure

The longitudinal online survey was approved by the Ethical Committee of the Faculty of Behavioral, Management and Social Sciences of the University of Twente. Subsequently, the implementation of the study started by means of participant recruitment. As a suitable sampling strategy, convenience sampling was applied. The online platform Test Subject Pool BMS (SONA) System of the University of Twente was used to find volunteer participants. Here, students of the University of Twente received a compensation of 2.5 SONA credits for their participation in the study. No compensation could be offered to participants external to the University of Twente. In addition to SONA systems, the survey subscription link was shared by means of social media, like inter alia Facebook.

The actual data collection took place in November 2019. Here, the recruited participants were instructed to register for the study by means of a valid email address and a password. This was followed by the request to install the TiiM application on their smartphone. A link to the apple store, as well as Google Play store, was provided to the participants. The total duration of the study was nine days. On day one, the participants received information about the background of the research and how it was set up. Moreover, they were informed about their rights regarding their participation in the study, and they were referred to contact information. Finally, the participants were instructed to give their informed consent to participate in the

study. The next seven days, day two until day eight, served the data collection regarding the daily questionnaires. Three times a day, all participants were instructed to respond to six questions via the TiiM application. As already stated, three fixed time frames were set up to answer the questions. In order to enhance the compliance to these time frames, participants received a reminder to complete the respective questionnaires on time. Moreover, participants had to complete all items in order to continue with the questionnaire. Finally, on day nine of the study, participants were instructed to complete the trait questionnaires. The Perceived Stress Scale (PSS) was the only trait measure, which was of interest for the present study.

Data analysis

The data analysis was conducted by means of SPSS Statistics v24. Descriptive statistics were calculated to represent participants characteristics, i.e. age and gender. Moreover, descriptive statistics were calculated to evaluate the trait stress questionnaire (PSS). A table was created to represent minimum as well as maximum scores, median, mean scores and standard deviations of trait stress were represented. In order to answer the first research question, a figure representing the median score for each measurement of state stress among the participants, was employed in order to visualize the data. Here, median scores have been used, since state stress was measured by means of an ordinal variable. After that, the participants were divided into three groups, based on their total scores on the PSS. The first group comprised participants who demonstrated low levels of baseline trait stress according to the State of New Hampshire Employee Assistance Program (EAP) cutoffs. The second group consisted of participants with moderate baseline trait stress levels. Finally, the third group encompassed all participants who fell in a high baseline trait stress category. Each group was represented by means of a graph, illustrating the median score for each measurement. In order to illustrate how state stress can fluctuate within individuals, the data of two participants with extreme stress scores were used. Here, the participant with the overall lowest and the one with the highest trait stress score was considered. This was done to illustrate the potential nonergodic nature of psychological phenomena, like stress, in which the results at the population level do not necessarily reflect within-person processes (Mehl & Conner, 2012, p. 47).

In order to investigate the second research question, the variable about the social context was added to the analysis of the data. Firstly, a visual representation in the form of a boxplot, was applied. Here, the variables trait stress, state stress and the presence of friends were considered. Secondly, in order to account for dependencies among measurements within participants, a linear mixed model (LMM) was applied. The LMM comprised a random

intercept over participants and a diagonal covariance matrix, as a more complex covariance structure (e.g. autoregressive) was not identifiable. Moreover, the model tested for a fixed effect regarding the presence of friends. The presence of friends constituted the independent variable, whereas state stress represented the dependent variable. Finally, results were presented in form of a table. To illustrate the findings, a figure representing the mean state stress scores in relation to the presence of friends was created. Thirdly, a second linear mixed model was applied, which additionally considered the variables trait stress and the potential interaction between trait stress and the presence of friends as independent factors. This model was intended to test for a possible interaction effect of trait stress and the presence of friends on state stress. Again, the results were represented in form of a table and by means of a visual representation of the interaction.

Results

Trait Stress and State Stress

Table 1 provides an overview of the results of the trait stress questionnaire (PSS). Here, minimum as well as maximum scores, median, mean scores and standard deviations of trait stress are represented. Generally, the results of the PSS revealed that the sample was moderately stressed in the baseline trait stress measurement. The trait stress scores ranged from 15 to 38 (M = 24.60, SD = 5.34). Hence, the participants fell in moderate and high trait stress categories. In total, 14 participants (40 % of the sample) demonstrated a score of 27 or above, indicating high trait stress, on the PSS. It was noteworthy that there was actually no participant who fell in a low trait stress category, which would have been indicated by a score of 14 or below on the PSS.

Table 1

Descriptive Data of the Perceived Stress Scale (PSS)

	Overall (n = 35)
Mean (SD)	24.60 (5.32)
Median [Min, Max]	25 [15.0, 38.0]

Figure 1 represents the median scores of state stress for all participants at the 21 measurement timepoints. A fluctuation of state stress over time is clearly present at the group level. Nevertheless, the median values were all within the central range of the 0-7 scale. Since the results of the PSS already revealed that the sample was moderately stressed in general, the median scores of state stress match the result of the baseline trait measurement. In other words, it could be stated that the fluctuation of state stress tended to operate within the respective baseline trait stress level of the participants.

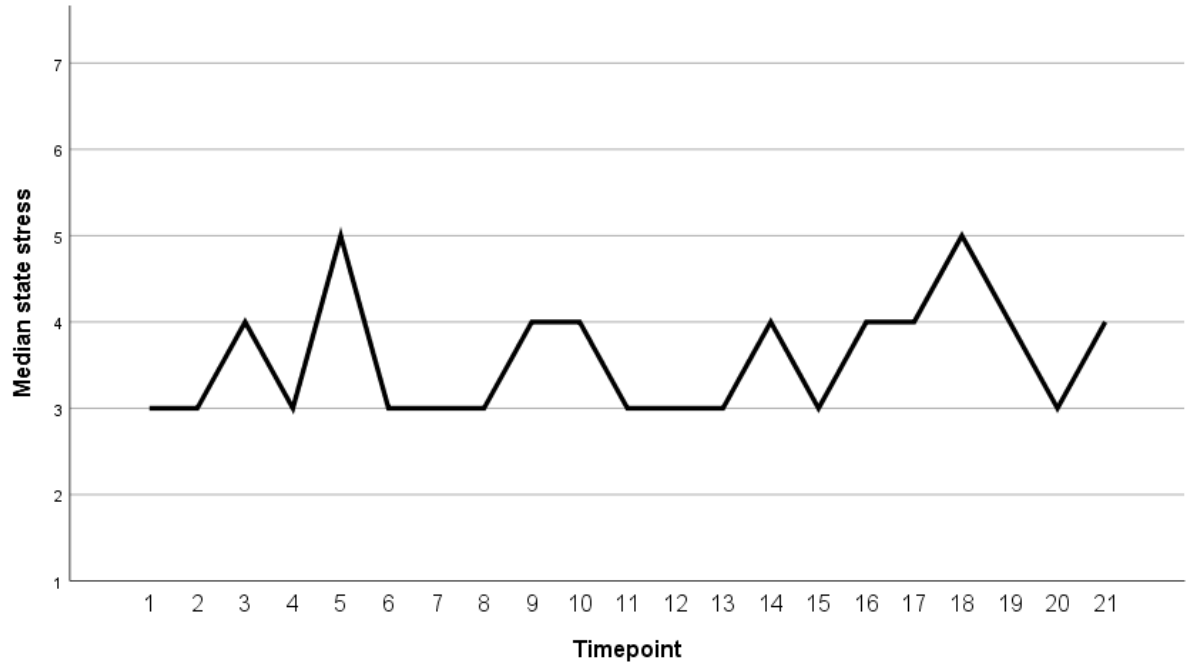

Figure 1

Median Scores of State Stress over time among all participants, (N=35)

Figure 2 represents a comparison of fluctuations of state stress within participants demonstrating different levels of baseline trait stress. Since there was no participant who fell in a low trait stress category, only two groups, moderate and high trait stress participants, were compared with each other. Notably, participants who fell in a moderate trait stress category, demonstrated similar fluctuations of state stress, as participants who fell in a high stress category. Nevertheless, the fluctuation of the high trait stress group consistently operated on a higher level of state stress than the fluctuation of the moderate trait stress group. This was in line with the findings of figure 1, where it was revealed that the fluctuation of the total sample operated within the respective trait stress level of the sample.

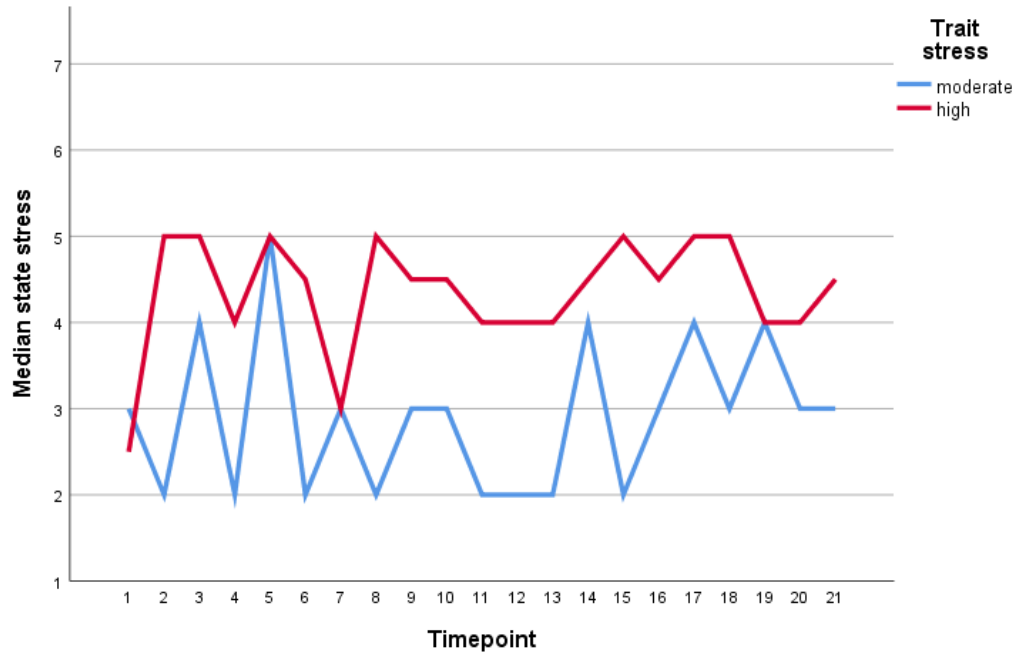

Figure 2

Median Scores of State Stress among High Trait Stress Participants and Moderate Trait Stress Participants Over Time

In Figure 3, the data of two extreme participants were used to illustrate how stress as a state fluctuates within individuals. These data actually revealed similar results. Firstly, the participant with the highest baseline stress level according to the PSS (total score of 38), demonstrated a fluctuation in state stress, which was operating within the upper center of the scale. In other words, the participant showed fluctuations of state stress, which operated within the respective baseline stress level. Secondly, the participant with the lowest baseline stress (total score of 15), showed fluctuations of state stress, which occurred within the lower bound of the scale. Hence, these cases suggest that state stress similarly fluctuates within individuals having high as well as low trait stress, but on a higher level within participants with higher trait stress.

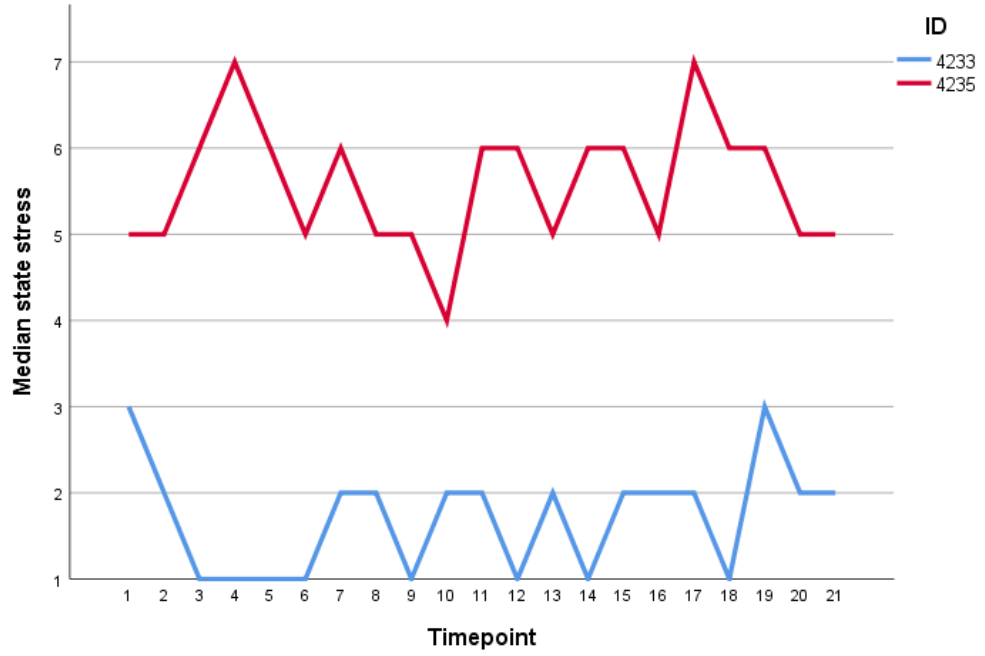

Figure 3

Respective State Stress Scores of the Highest and Lowest Trait Stress Participant over time

Stress and the Presence of Friends

Within the sample of the present study, there were generally more measurements without the presence of friends than with friends. Deductive from a visual analysis of figure 4, it could be assumed that there was an effect of trait stress on state stress among the sample. Individuals who fell in a moderate baseline stress category, demonstrated lower levels of state stress on average than individuals who fell in the high trait stress category. In other words, the higher the baseline trait level of stress, the higher was the state level of stress. Moreover, the figure suggested a trend of an effect of the presence of friends on state levels of stress. Nevertheless, this effect appeared only among individuals who fell in a high trait stress category. Therefore, it could be assumed that the higher the baseline stress level, the more significant the association between the presence of friends and state stress. Hence, the results of figure 4 suggested a potential interaction effect of trait stress on the relation between the presence of friends and state stress.

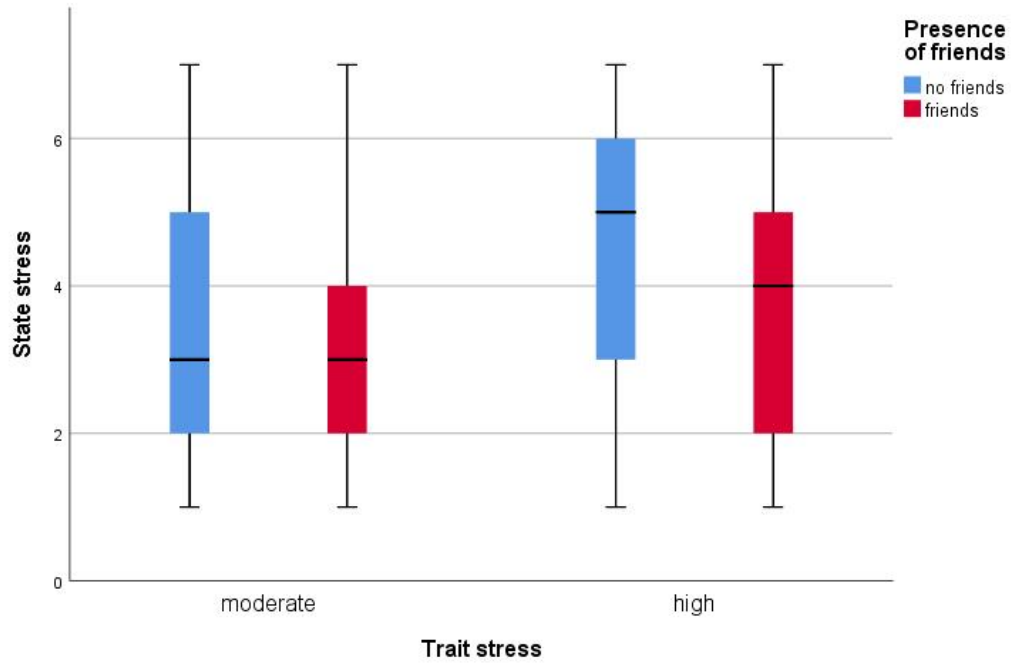

Figure 4

Boxplot of State Stress among moderate and high trait stress participants with regard to the presence of friends

Results of the linear mixed model, however, did not confirm that there was an overall statistically significant effect of the presence of friends on the level of state stress within the present sample. Deductive from table 2, state stress tended to decrease by 0.234 points on the 0-7 stress scale when friends were present. Although the sample seemed to be less stressed in the presence of their friends (figure 4), this effect was not significant.

Table 2

Linear Mixed Model of Fixed Effects for the variables state stress and the presence of friends

	Estimate (SE)	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound	Sig
Intercept	3.381 (.148)	3.090	3.671	<.001
Friends	-0.234 (.163)	-0.555	0.086	.151

Note. Dependent variable: State Stress

Due to the fact that the boxplot in figure 4 suggested that there might be an interaction effect of trait stress and the presence of friends on state stress, a further linear mixed model was applied, in which the variables to be considered, were extended. Trait stress and the interaction of trait stress and the presence of friends, were added as predictors to the linear mixed model.

When the variable trait stress was added to the model, the effect of presence of friends on state stress stayed the same. Similarly, it turned out that mean state stress scores tended to be slightly lower when friends were present (figure 5). This held true for both groups, participants with moderate baseline trait stress and participants with high trait stress. Nevertheless, the results of table 3 revealed that the main effect of presence of friends on state levels of stress remained not significant. Moreover, it was illustrated that after the addition of trait stress to the linear mixed model, an interaction effect, as suggested in figure 4, was not present ($p = 0.980$). A visual inspection, represented in figure 5, supports this finding, since the lines did not differ between high and low trait stress groups as would be expected in the presence of an interaction effect. Nevertheless, deductive from table 3, it became evident that trait stress remained a significant predictor of state stress ($p < 0.001$) within the sample. The effect size showed that the respective state stress level was 1.025 higher for students in the high trait stress category (table 3).

Table 3

Linear Mixed Model for Fixed Effects for the variables state stress, trait stress and the presence of friends

	Estimate (SE)	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound	Sig
Intercept	3.975 (.219)	3.544	4.407	<.001
Friends	-0.255 (.244)	-.733	0.223	.295
Trait stress	1.025 (.284)	0.467	1.583	.001
Trait x friends	0.008 (.315)	-0.610	0.626	.980

Note. Dependent variable: State Stress

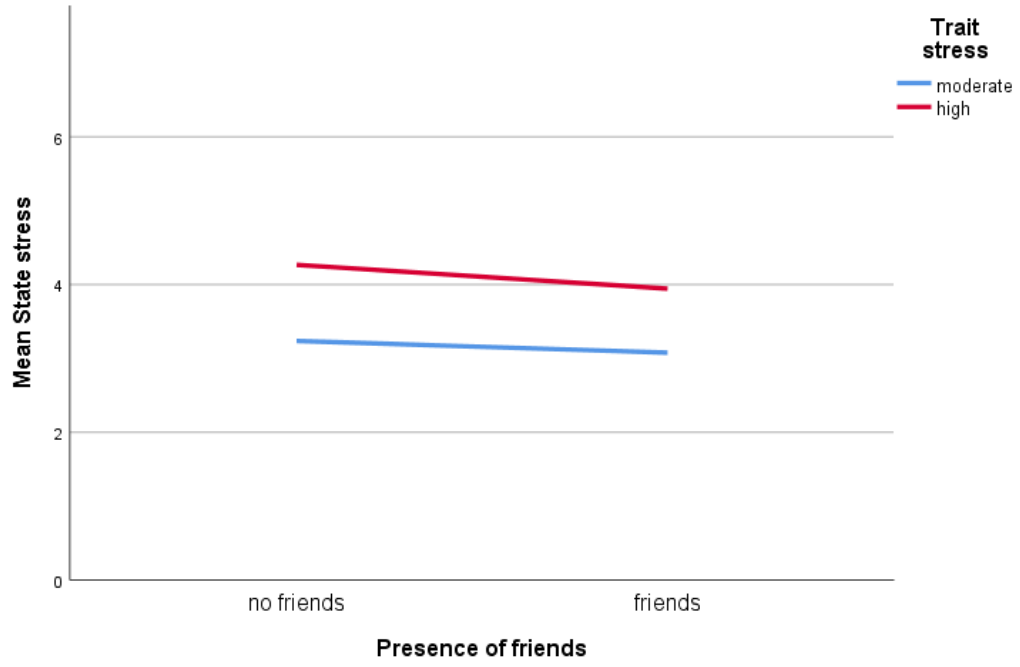

Figure 5

Interaction of Trait Stress, State Stress, and the Presence of Friends

Discussion

Key Findings

The aim of the current experience sampling study was to investigate how the presence of friends is associated with fluctuations of stress within university students. For this, state as well as trait stress was examined. It was found that trait stress scores were high and state stress clearly fluctuated within individuals over time. The fluctuations of state stress were found to be dependent of the respective trait level of stress and trait levels of stress significantly predicted state levels of stress. A significant effect of the presence of friends on fluctuations of stress could not be found within the present sample. Although a tendency towards an interaction effect of the presence of friends and trait stress on state stress was revealed in visual analysis, suggesting that the stress reducing effect of the presence of friends was stronger for people with high trait stress, this interaction effect was not statistically confirmed.

Generally, the results of the present study showed that the sample was moderately stressed regarding both state and trait levels of stress. Almost half of the sample even demonstrated high levels of trait stress according to the established scale of the State of New Hampshire Employee Assistance Program (EAP). The fact that no participant demonstrated low levels of stress was in line with the findings of previous research, suggesting a very high prevalence of stress among students (Winerman, 2017). Hence, the present study provides further evidence that high stress is a very common phenomenon among and within students in the modern world. This result is alarming, since previous research already found a link between stress among students and cognitive impairments, as well as lower academic achievement (Aafreen, Priya, & Gayathri, 2018; Dyrbye et al., 2011; Stallman, 2010).

The results of the present study were also in line with Fredrickson's suggestion that emotions can be considered as affective states, which are highly context-dependent and variable over time (Fredrickson, 2004, p.146). Within the present sample, stress as an emotion manifested itself as inherently dynamic. Because of the application of the Experience Sampling Method for the present study, fluctuations of state stress over time could be found on the group level, as well as on the individual level. In addition to that, these fluctuations were found to be dependent of the respective trait level of stress. Hence, the first research question could be answered by stating that stress fluctuates within university students perceiving moderate as well as high levels of stress over time. Moreover, it could be stated that trait levels of stress were found to predict state levels of stress within individuals. Previous research already revealed that stress beliefs, the subjective appraisal and perception of stress, constitute a crucial factor in determining the stress level and response (Crum, Salovey, & Achor, 2013; Hannibal & Bishop,

2014). Hence, it might be possible that students who are generally more stressed than others, perceive momentary stress situations fundamentally different, possibly as more extreme, which manifests itself in respective high state levels of stress. Stress beliefs might constitute an underlying factor within the relationship between trait and state levels of stress. Nevertheless, further research is needed in regard to this. Here, it would be crucial to not only consider stress beliefs as relatively stable characteristics, but also as states, operating in momentary conditions. Further application of ESM is thus highly recommended for the purpose of investigating stress beliefs.

By examining the second research question, it became clear that none of the applied linear mixed models could reveal a significant effect of the presence of friends on the levels of stress. Generally, the results of the present study did not confirm the hypothesis that there is a negative correlation between momentary stress as a state-like construct and being in the presence of friends. This hypothesis was based on previous studies, which found that the presence of friends constitutes a buffering factor against the negative consequences of stress (Cohen & Hoberman, 1983; Rubin et al., 1992). In this study, significantly reduced levels of stress in the presence of friends could not be found. However, within the present study only stress itself was examined, and not the consequences of stress. Thus, it might be possible that stress levels themselves do not decrease in the presence of friends, but the potentially severe consequences of stress, like inter alia medical, psychological and academic problems, are reduced. In addition to that, the present study only focused on the presence of friends versus being alone or in the company of other people than friends. The social context additionally encompassed the categories ‘Family’, ‘Partner’, ‘Fellow Students, Co-Worker’, ‘Other’, and ‘I am alone’ and it was possible to select several answer categories at the same time. Nevertheless, the present study exclusively considered whether friends were present or not. Accordingly, it is possible that the presence of others, besides friends, in this category might have affected the results. For instance, fellow students might also be considered as friends by some participants, who indicated that they were just in the presence of their fellow students. Moreover, it might be possible that the presence of for example family members or co-workers, strengthened or weakened the effect of the presence of friends on stress. It is also worth mentioning, that there were much more measurements without the presence of friends than with friends among the sample. This resulted in an unequal distribution of the data and loss of predictive power, which might have contributed to the result of the present study. Moreover, the current study only examined current social context while it might be possible that there was a time-lagged effect, in which the effect of the presence of friends was delayed in time. Nevertheless, such an effect

can only be found by means of a time-lagged model. Generally, re-analyses of the data, as well as further research about the topic is needed to draw any conclusions about these assumptions. Based on the results of the current study, the second research question could be answered by stating that the presence of friends does not significantly affect momentary stress states within students over time. Nevertheless, since the slope of the high trait stress group was slightly greater than the slope of the moderate trait stress group, and a tendency towards an interaction effect of the variables could be present. To test this, a larger sample size might be required as for statically confirming interaction effects, sample sizes generally need to be much larger than for main effects (Aguinis, Beaty, Boik, & Pierce, 2005).

In sum, the present research provides evidence that trait levels of stress predict state levels of stress within university students over time. This means that students with high baseline trait stress, feel more stressed in their daily life. However, within the sample of the present study, a significant effect of presence of friends on stress and its fluctuations could not be found.

Strengths and Limitations

The primary strength of the present study is its high ecological validity through the application of the experience sampling method (ESM), which allowed to assess feelings of stress associated with the presence of friends, as they unfold within individuals in real time in their daily life. However, the present study also showed to have some limitations that should be considered, since they might have influenced the results. Firstly, during the data collection there were some technical difficulties with the TiiM device. The daily questions did not disappear after the fixed timeframe of two hours for each measurement. This means that the participants could have answered the questions later than intended. This might have reduced the ecological validity of the present study, due to inter alia the recollection bias. Secondly, during the data analysis it became apparent that there were much more measurements without the presence of friends than with friends. This means that the data was not equally distributed, which might have biased the results. Moreover, the sample size was relatively small, especially for testing an interaction effect. Hence, it might be possible that the present study was underpowered because there were much more measurement points without than with friends. A larger sample size based on prior power calculations could counteract this limitation.

Future research

By conducting this study, it became evident that several questions regarding stress and the presence of friends remain unanswered. Therefore, it is important to examine these variables and their relations further. For future research it is recommended to examine stress more in depth. It is advisable to apply ESM, as it became evident in this research that this method enables researchers to assess stress over time as it unfolds within individuals in real time in the context of their daily life. Nevertheless, a single item to assess the concept of stress may be too generic and insufficient to draw explicit conclusions about stress and its potentially severe consequences. Hence, further items should be formulated and taken into account. For instance, it might be interesting to include an item regarding the stress beliefs, since previous research identified such beliefs as having a detrimental role in determining stress and stress responses. For future research, it would be of special interest to consider stress beliefs as states, operating in momentary conditions. In addition to that, the scale regarding state stress should be extended in order to draw more meaningful conclusions about the to be studied phenomenon. For instance, it might be possible that individuals perceive a stress score of three completely different. Because of that, future research should consider employing additional items to assess state stress more precisely. Moreover, a larger sample size might be required to test whether there is indeed an interaction effect of the presence of friends and trait stress on state stress. Further research should also consider the social context in more detail. Instead of just focusing on the presence of friends, additional persons from the social context should be taken into account, as possible factors influencing stress and hence the result of the present study.

Conclusion

Generally, the results of the present study call attention to the alarmingly high levels of stress among university students. Previous studies already highlighted the potentially severe consequences of high stress. Therefore, it is crucial to address stress more in depth, and to design interventions in the future, which aim to counteract the developments of stress as an integral part of the modern world's everyday life. The present study suggested that ESM represents a suitable method to gain insight into patterns of stress and related factors within persons in their real-life context. The findings confirmed that stress is actually a psychological phenomenon, which is inherently dynamic and fluctuates within individuals over the course of time. Nevertheless, the present study could not find evidence that the presence of friends affects these fluctuations. Until now, it is only clear that trait stress predicts levels of state stress. Nevertheless, it is not known which contextual factors further contribute to these fluctuations of state stress over time. It remains a matter of urgency to conduct more ESM research about the topic, in order to further move towards understanding, predicting, counteracting or even preventing stress and its potentially harmful effects on individuals in modern societies.

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